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Translation of Japanese Patent Application Laid-Open No.  
H10-97122

**ELECTROPHOTOGRAPHIC DEVICE**

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[ABSTRACT]

[Problem] To provide an electrophotographic device capable of maintaining a high image quality without any streaming or blurring of an image even at a high humidity from the beginning of use until repeated use, even when an alternating-current voltage is superimposed/applied onto a direct-current voltage to repeatedly charge an image carrying member.

[Solution Means] An electrophotographic device comprising: a rotatable image carrying member; and at least charging means, developing means, and cleaning means from an upstream side, wherein direct-current and alternating-current voltages are applied to charge the image carrying member, and a ratio of a time for applying the alternating-

current voltage with respect to a total rotation time of the image carrying member is 75% or less.

[CLAIMS]

[Claim 1] An electrophotographic device comprising: a rotatable image carrying member; and at least charging means, developing means, and cleaning means from an upstream side, wherein direct-current and alternating-current voltages are applied to perform charging, and a ratio of a time for applying the alternating-current voltage with respect to a total rotation time of the image carrying member is 75% or less.

[Claim 2] The electrophotographic device according to claim 1, wherein the charging is direct charging.

[Claim 3] The electrophotographic device according to claim 1, wherein a surface layer of the image carrying member contains a resin including a bridging structure.

[Claim 4] The electrophotographic device according to claim 1, wherein the image carrying member is an electrophotographic photosensitive member.

[Claim 5] The electrophotographic device according to claim 4, wherein the electrophotographic photosensitive member includes a conductive support member and a photosensitive layer in this order.

[Claim 6] The electrophotographic device according to claim 5, wherein the electrophotographic photosensitive member further includes a surface protective layer on the

photosensitive layer.

[Claim 7] The electrophotographic device according to claim 5 or 6, wherein the photosensitive layer includes a charge generation layer and a charge transport layer in this order.

[Claim 8] The electrophotographic device according to claim 6, wherein the surface protective layer contains conductive particles.

[Claim 9] The electrophotographic device according to claim 8, wherein the conductive particles are metal oxide particles.

[Claim 10] The electrophotographic device according to claim 9, wherein the metal oxide particles are subjected to a water-repellent treatment.

[Claim 11] The electrophotographic device according to claim 6, wherein the surface protective layer contains resin particles containing a fluorine atom.

[Claim 12] The electrophotographic device according to claim 1, wherein the cleaning means is blade cleaning means.

[Claim 13] The electrophotographic device according to claim 12, wherein a blade of the cleaning means is an elastic rubber.

[Claim 14] The electrophotographic device according to claim 12 or 13, wherein an abutment pressure of the blade of the cleaning means onto the image carrying member is in a range of 3 to 50 g/cm.

[Claim 15] The electrophotographic device according to any

one of claims 12 to 14, wherein an abutment angle of the blade of the cleaning means onto the image carrying member is in a range of 10 to 45 degrees in a counter direction with respect to a rotation direction of the image carrying member.

[Claim 16] The electrophotographic device according to claim 3, wherein the resin including the bridging structure is a hardening acrylic resin or a hardened methacrylic monomer or oligomer resin.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field of the Invention] The present invention relates to an electrophotographic device, particularly to an electrophotographic device including a rotatable image carrying member, and at least charging means, developing means, and cleaning means from an upstream side, so that direct-current and alternating-current voltages are applied to perform charging.

[0002]

[Related Art] Corona discharge devices such as corotron and scorotron have broadly been used as means/apparatus for executing a step of uniformly charging/treating the surface of an electrophotographic photosensitive member, electrostatic recording dielectric member or the like as an image carrying member in image forming devices such as an electrophotographic device and an electrostatic recording device. In this device, a high voltage (e.g., DC5 to 8 kV)

is applied to discharge electrodes such as a metal wire and a discharge needle, and accordingly generated coronas are allowed to function on the surface of the image carrying member (hereinafter referred to as the photosensitive member) which is a member to be charged to charge the member.

[0003] However, a corona discharge unit requires an expensive high-voltage power supply, and spaces such as a space for the unit and a shield space of the high-voltage power supply. Since a large amount of corona products such as ozone and NO<sub>x</sub> are generated at a corona generation time, additional means/mechanism is required for handling the products, and this is a factor for increases of a size and cost of the device. The surface of the photosensitive member changes in quality by the generated corona products so that image blurring and degrading proceed. An image quality is adversely influenced by dirt on a discharge wire to cause an image mull portion or black streak. For a power, only 5 to 30% of the current turns to the photosensitive member surface, most of the current flows into a shield plate, and charging means is inferior in efficiency. These and other problems occur.

[0004] To solve the problems, in recent years, the use of a direct charging system has been studied instead of the corona discharge unit which has many problems. In the direct charging, conductive members (members for charging) such as a roller and a brush to which the voltage is

applied by the power supply are brought into contact with the surface of the member to be charged, and the charge is directly injected into the surface of the member to be charged to directly charge the surface of the member to be charged at a predetermined potential. Various systems have been researched and a large number of systems have been proposed (Japanese Patent Application Laid-Open Nos. S56-91253, S56-104351, S56-185166, S56-194349, S57-178267, S58-40566, S58-139156, S58-150975, S60-147756 and the like). The systems have characteristics that the voltage can be reduced, the corona products are hardly generated, and constitution is simplified.

[0005] However, in actual, even when the photosensitive member is charged/treated by the above-described contact charging method, portions of the photosensitive member surface are not uniformly charged, and spotted charging unevenness is caused. For example, in a reverse developing system, even when a process subsequent to optical image exposure is applied to the photosensitive member in the spotted charging unevenness, an output image is a spotted black point image in accordance with the spotted charging unevenness. In a forward developing system, there are defects that a spotted white point image is formed in accordance with the spotted unevenness, and a high-quality image is not obtained. To solve the problem, it has been proposed that a direct-current voltage be superimposed upon an alternating-current voltage to uniformly charge the

member (see Japanese Patent Application No. S61-298419).

[0006] When the image forming devices such as a copying machine are cleaned to remove toner from the image carrying member, blade edges such as a urethane rubber are allowed to abut on the image carrying member surface, and residual toner is removed. This cleaning method is known, and effective from viewpoints of miniaturization and simplification of the device and a large cleaning effect.

[0007] Moreover, the electrophotographic photosensitive member for use as the image carrying member is required to have a necessary sensitivity, and electrical and optical characteristics in accordance with an electrophotographic process for use. Furthermore, for the repeatedly used photosensitive member, since electrical and mechanical external forces are directly applied to the surface layer of the photosensitive member, that is, a layer most distant from the support member in the charging, toner developing, transfer to paper, cleaning treatment and the like, durability against the forces is required. Concretely, the durability is required against generation of friction or damage on the surface by sliding contact, degradation of the surface by ozone generated at a charging time and the like.

[0008] On the other hand, there is also a problem that the toner adheres to the surface layer by the repetition of the toner developing and cleaning, and therefore cleaning properties of the surface layer are required to be enhanced.



[0009] An attempt has been made to dispose a surface protective layer containing a resin as the main component in order to satisfy the characteristics required for the surface layer. For example, as proposed in Japanese Patent Application Laid-Open No. S57-30843, a protective layer whose resistance is controlled by addition of metal oxide as conductive powder has been proposed.

[0010] However, the method which has heretofore been used has a problem in dispersibility or cohesiveness in a binding resin of metal oxide particles, or conductivity and transparency in the use of the protective layer, and phenomena easily occur such as nonuniformity of the protective layer surface, image defect by the unevenness, rise of residual potential by repeated charging, and sensitivity drop.

[0011] As a result of study, as described in Japanese Patent Application Laid-Open No. H4-226469, the present inventors have found that the dispersibility of ultrafine metal oxide particles is remarkably improved by the use of the resin containing hardening acrylic monomer or oligomer and that a homogeneous electrophotographic photosensitive member having no image defect and having high hardness is obtained in a case where the particles are used in the protective layer.

[0012] Moreover, since water absorptivity of the metal oxide surface is high, and resistance of the protective layer also changes by a degree of water absorption,

resistance depends on environments, and it has been difficult to appropriately reduce the resistance in the whole environment only by addition of metal oxide as the conductive particles. To solve the problem, for example, in Japanese Patent Application Laid-Open No. S62-295066, it has been proposed that the resistance of the layer be controlled by the use of the protective layer including fine metal powder or fine metal oxide powder whose dispersibility and resistance to humidity are enhanced by water-repellent treatment and which is dispersed in the binding resin.

[0013] However, a current amount increases in a case where the alternating-current voltage is superimposed/applied onto the direct-current voltage to charge the image carrying member. Accordingly, a generated amount of charged products such as ozone and NOx also increases. Therefore, even when the original surface resistance of the image carrying member is controlled, the charged products are accumulated by the repetition of the charging, and the surface resistance drops. Especially, there has been a problem of stream or blurring of the image at a high humidity.

[0014]

[Problems to be solved by the Invention] An object of the present invention is to provide an electrophotographic device which solves the above-described problem and which is capable of maintaining a high image quality without any

streaming or blurring of an image even at a high humidity from the beginning of use until repeated use, even when an alternating-current voltage is superimposed/applied onto a direct-current voltage to repeatedly charge an image carrying member.

[0015]

[Means for solving the Problem] That is, according to the present invention, there is provided an electrophotographic device comprising: a rotatable image carrying member; and at least charging means, developing means, and cleaning means from an upstream side, wherein direct-current and alternating-current voltages are applied to perform charging, and a ratio of a time for applying the alternating-current voltage with respect to a total rotation time of the image carrying member is 75% or less.

[0016]

[Mode for Carrying out the Invention] An image carrying member for use in the present invention is largely classified into an electrostatic recording member including a resin layer called a dielectric layer, and an electrophotographic photosensitive member including a photosensitive layer. When the image carrying member is the electrophotographic photosensitive member, the constitution is roughly classified into a constitution including the photosensitive layer constituting a surface layer on a conductive support member, and a constitution further including a protective layer on the photosensitive

layer. Examples of the photosensitive layer include a single layer type including both a charge generation material and a charge transport material in the same layer, a laminate type in which a charge generation layer containing the charge generation material and a charge transport layer containing the charge transport material are laminated and the like. When the protective layer is disposed, photosensitive member characteristics are degraded by migration of protective layer components into the photosensitive layer. Because of this problem, the laminate type photosensitive layer is more preferable. The examples of the constitution of the photosensitive layer of the laminate type include a constitution in which the charge generation layer and charge transport layer are stacked on the conductive support member in this order, and a constitution in which conversely the charge transport layer and charge generation layer are stacked in this order. However, in the present invention, the stacking of the charge generation layer and charge transport layer in order is more preferable.

[0017] Any conductive support member is used in the present invention as long as the member has conductivity, and the examples of the member include: a drum or a sheet molded of metals such as aluminum, copper, chromium, nickel, zinc, and stainless steel; a plastic film on which a metal foil of aluminum, copper or the like is laminated; a plastic film on which aluminum, indium oxide, tin oxide or

the like is deposited; a metal, plastic film, or paper coated with a conductive material alone or together with the binding resin to constitute a conductive layer; and the like.

[0018] For the charge generation layer of the laminate type photosensitive member, the charge generation materials such as: azo pigments such as Sudan red and Dian blue; quinone pigments such as pyrene quinone and anthanthrone; a quinocyanine pigment; a perylene pigment; indigo pigments such as indigo and thioindigo; and a phthalocyanine pigment are dispersed in binding agent resins such as polyvinyl butyral, polystyrene, polyvinyl acetate, and acrylic resin. This dispersant is applied, or the pigment is vacuum vapor deposited to form the charge generation layer. The charge generation layer has a film thickness of 5  $\mu\text{m}$  or less, preferably 0.05 to 3  $\mu\text{m}$ .

[0019] The charge transport layer of the laminate type photosensitive member is formed by the use of a coating solution in which the charge transport materials such as a pyrazoline compound, hydrazone compound, styryl compound, and triarylamine compound are dissolved in a resin having a film forming property. The examples of the resin having the film forming property include polyester, polycarbonate, polystyrene, polymethacrylic ester and the like. The charge transport layer has a thickness of 5 to 40  $\mu\text{m}$ , preferably 10 to 30  $\mu\text{m}$ .

[0020] In the present invention, as the material of the

photosensitive layer, in addition to the above-described materials, deposited films such as Se, Se-Te alloy, Se-As alloy, Se-Sb alloy, and Se-Bi alloy, organic photoconductive layers such as PVK/TNF, an amorphous Si photosensitive layer, and inorganic photoconductive member of ZnO or CdS dispersed in the binding resin are usable.

[0021] The examples of the binding resin usable in the protective layer of the present invention include a polycarbonate resin, polyester resin, polyarylate resin, polystyrene resin, polyethylene resin, polypropylene resin, polyurethane resin, acrylic resin, epoxy resin, silicone resin, cellulose resin, polyvinylchloride resin, phosphazene resin, melamine resin, vinyl chloride-vinyl acetate copolymer and the like. These resins are usable alone or as a combination of two or more.

[0022] Among the above-described resins, it is preferable to use the hardening resin from the viewpoints of surface hardness of the protective layer, wear resistance, dispersibility of particulates, and stability after dispersion. That is, the above-described conductive particles and the fluorine atom containing resin particles are dispersed in a solution containing monomer or oligomer which hardens by heat or light to form the coating solution for the protective layer, the photosensitive layer is coated with this solution and hardened to form the protective layer, and this layer is more preferable in the dispersibility, hardness, wear resistance and the like.

[0023] Monomer or oligomer which hardens by heat or light includes a functional group which causes a polymerization reaction on a terminal end of a molecule by a heat or light energy, a comparative large molecule having about 2 to 20 repetitions of a molecular structure unit is oligomer, and a smaller molecule is monomer. The examples of the functional group which causes the polymerization reaction include: groups including carbon-carbon double bond, such as an acryloyl group, methacryloyl group, and vinyl group; a silanol group; further groups which cause a ring-opening polymerization, such as an annular ether group; two or more types of molecules which react and cause polymerization, such as phenol and formaldehyde; and the like. When the layer is coated with the coating solution containing these, and hardened to form the protective layer, the resin has a bridging structure, and obtains a high hardness. Above all, monomer or oligomer especially including the acryloyl or methacryloyl group is superior in dispersibility.

[0024] In the present invention, additives such as a radical scavenger and oxidation inhibitor may also be added to the protective layer for a purpose of further enhancing the dispersibility, binding property, and weather resistance.

[0025] In the present invention, the protective layer has a film thickness in a range of preferably 0.2 to 10  $\mu\text{m}$ , more preferably 0.5 to 6  $\mu\text{m}$ .

[0026] In the present invention, the surface layer of an

image holding member especially preferably contains lubrication particles for further enhancement of a cleaning or transfer property. The fluorine atom containing resin particles are preferable as the lubrication particles. For the fluorine atom containing resin particles for use in the present invention, one or two or more are preferably appropriately selected from polytetrafluoroethylene, polytrifluoroethylene chloride, polyhexafluoroethylene propylene, polyvinyl fluoride, polyvinylidene fluoride, ethylene difluoride dichloride, and copolymers of these, but especially polytetrafluoroethylene and polyvinylidene fluoride are preferable. A molecular weight of resin particles, or a particle diameter of particles can be appropriately selected, and is not especially limited.

[0027] A ratio of the fluorine atom containing resin particles in the protective layer is preferably 5 to 70% by weight, more preferably 10 to 60% by weight with respect to a surface layer total weight. When the ratio of the fluorine atom containing resin particles is larger than 70% by weight, a mechanical strength of the surface layer easily drops. When the ratio of the fluorine atom containing resin particles is smaller than 5% by weight, a mold releasing property of the surface layer surface, wear resistance of the surface layer, and resistance to damage are not sufficient in some case.

[0028] In the present invention, the protective layer may contain a fluoric surfactant, fluoric silane coupling agent,



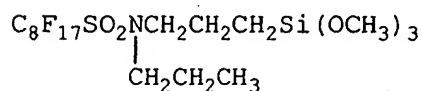
fluoric silicone oil, or fluoric graft polymer in order to prevent the fluorine atom containing resin particles from agglutinating with one another in the resin solution. When the above-described fluorine atom containing compound is contained, the dispersibility and dispersion stability of the fluorine atom containing resin particles in the resin solution are remarkably enhanced, and the coating solution having a very satisfactory dispersibility is obtained.

[0029] An addition amount of these fluorine atom containing compounds is preferably 0.1 to 50% by weight, especially preferably 1 to 30% by weight with respect to the weight of the fluorine atom containing resin particles.

[0030] The preferable examples of the fluoric silane coupling agent, fluoric silicone oil, fluoric surfactant, and fluoric graft polymer usable in the present invention are as follows, but are not limited to these compounds.

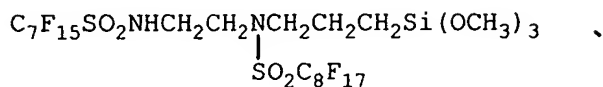
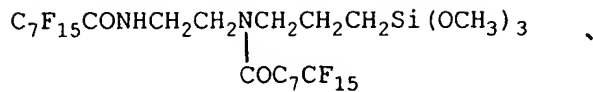
[0031] The preferable examples of the fluoric silane coupling agent include  $\text{CF}_3\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ ,  $\text{C}_4\text{F}_9\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ ,  $\text{C}_6\text{F}_{13}\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ ,  $\text{C}_8\text{F}_{17}\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ ,  $\text{C}_8\text{F}_{17}\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_2\text{CH}_2\text{OCH}_3)_3$ ,  $\text{C}_{10}\text{F}_{21}\text{Si}(\text{OCH}_3)_3$ ,  $\text{C}_{16}\text{F}_{13}\text{CONHSi}(\text{OCH}_3)_3$ ,  $\text{C}_8\text{F}_{17}\text{CONHSi}(\text{OCH}_3)_3$ ,  $\text{C}_7\text{F}_{15}\text{CONHCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ ,  $\text{C}_7\text{F}_{15}\text{CONHCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OC}_2\text{H}_5)_3$ ,  $\text{C}_7\text{F}_{15}\text{COOCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ ,  $\text{C}_7\text{F}_{15}\text{COSCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ ,  $\text{C}_8\text{F}_{17}\text{SO}_2\text{NHCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OC}_2\text{H}_5)_3$ ,

[0032]



$\text{C}_8\text{F}_{17}\text{CH}_2\text{CH}_2\text{SCH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ ,  $\text{C}_{10}\text{F}_{21}\text{CH}_2\text{CH}_2\text{SCH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ .

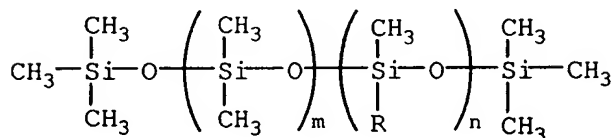
[0033]



and the like.

[0034] The preferable examples of the fluoric silicone oil include:

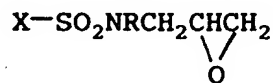
[0035]



and the like, where R denotes  $-\text{CH}_2\text{CH}_2\text{CF}_3$ , and m and n denote positive integers.

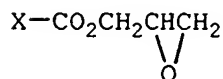
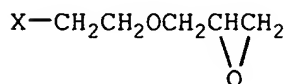
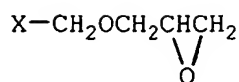
[0036] The preferable examples of the fluoric surfactant include  $\text{X}-\text{SO}_2\text{NRCH}_2\text{COOH}$ ,  $\text{X}-\text{SO}_2\text{NRCH}_2\text{CH}_2\text{O}(\text{CH}_2\text{CH}_2\text{O})_n\text{H}$  ( $n = 5, 10, 15$ ),  $\text{X}-\text{SO}_2\text{N}(\text{CH}_2\text{CH}_2\text{CH}_2\text{OH})_2$ ,  $\text{X}-\text{RO}(\text{CH}_2\text{CH}_2\text{O})_n\text{H}$  ( $n = 5, 10, 15$ ),  $\text{X}-(\text{RO})_n\text{H}$  ( $n = 5$  to  $20$ ),  $\text{X}-(\text{RO})_n\text{RH}$  ( $n = 5$  to  $20$ ),

[0037]



$\text{X}-\text{COOH}$ ,  $\text{X}-\text{CH}_2\text{CH}_2\text{COOH}$ ,  $\text{X}-\text{ORCOOH}$ ,  $\text{X}-\text{ORCH}_2\text{COOH}$ ,  $\text{X}-\text{SO}_3\text{H}$ ,  $\text{X}-\text{ORSO}_3\text{H}$ ,  $\text{X}-\text{CH}_2\text{CH}_2\text{OH}$ .

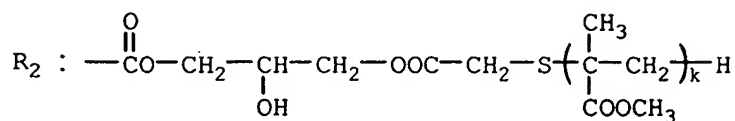
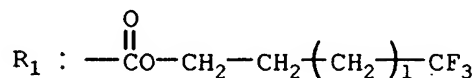
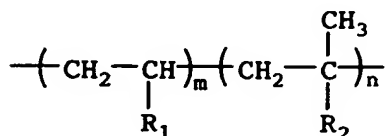
[0038]



and the like, where R denotes an alkylene group, arylene group, or aralkylene group (it is to be noted that R of -NRCH<sub>2</sub>- denotes an alkyl group, aryl group, or aralkyl group), and X denotes carbon fluoride groups such as -CF<sub>3</sub>, -C<sub>4</sub>F<sub>9</sub>, and -C<sub>8</sub>F<sub>17</sub>.

[0039] The preferable examples of the fluoric graft polymer include:

[0040]



(m, n, l, and k denote integers)

[0041] The examples of a material of a blade for use in blade cleaning means in the present invention include a rubber, plastic, metal, ceramic and the like, and above all, an elastic rubber blade is superior in the cleaning property as compared with the other materials. The examples of the elastic rubber material include an urethane

rubber, neoprene rubber, silicon rubber and the like, and the urethane rubber is especially preferable in that elasticity can be maintained over a long period.

[0042] The blade cleaning means in the present invention may include only a cleaning function of a developing agent, and an abutment pressure of the cleaning blade onto the image carrying member is preferably necessarily minimum. To minimize damages on the image carrying member surface, and further to effectively remove the residual developing agent, an abutment angle and pressure of the blade edge onto the image carrying member may be adjusted, the abutment angle is 10 degrees or more, especially preferably 45 degrees or less in a counter direction with respect to a movement direction of the image carrying member, and the abutment pressure is preferably 1 to 60 g/cm, especially preferably 3 to 50 g/cm.

[0043] The present invention will be described hereinafter in more detail in accordance with examples and comparative examples.

[0044]

(Example)

(Example 1) A 30 $\phi$ , 254 mm aluminum cylinder was used as a support member, the support member was coated with a coating formed of the following materials in an immersion coating method, and the member was thermally hardened at 140°C for 30 minutes to form a 15  $\mu$ m conductive layer.

[0045]

Conductive pigment: titanium oxide coated/treated with tin oxide 10 parts (by weight, this also applies to the following)

Pigment for resistance adjustment: titanium oxide 10 parts

Binding resin: phenol resin 10 parts

Leveling agent: silicone oil 0.001 part

Solvent: methanol/methyl cellosolve = 1/1 20 parts

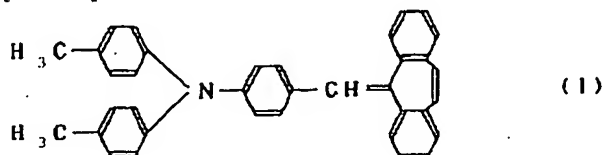
[0046] Next, this conductive layer was coated with a solution in which 3 parts of N-methoxymethyl nylon and 3 parts of copolymer nylon were dissolved in 65 parts of methanol and 30 parts of n-butanol in the immersion coating method to form a 0.5  $\mu\text{m}$  intermediate layer.

[0047] Next, 4 parts of oxytitanium phthalocyanine whose brushing angle  $2\theta \pm 0.2^\circ$  in X-ray diffraction of  $\text{CuK}\alpha$  had a strong peak at  $9.0^\circ$ ,  $14.2^\circ$ ,  $23.9^\circ$ ,  $27.1^\circ$ , 2 parts of polyvinyl butyral (trade name: Esreck MB-2, manufactured by Sekisui Chemical Co., Ltd.), and 80 parts of cyclohexanone were dispersed by a sand mill device using  $\phi$  1 mm glass beads for four hours. Thereafter, 115 parts of methyl ethyl ketone were added to obtain a dispersion solution. The intermediate layer was coated with the solution by the immersion coating method to form a 0.3  $\mu\text{m}$  charge generation layer.

[0048] Next, 10 parts of charge transport material represented by the following formula (I) and 10 parts of polycarbonate (weight average molecular weight 25000) were dissolved in 30 parts of monochlorobenzene and 30 parts of

dichloromethane to obtain a solution for the charge transport layer. The charge generation layer was coated with this solution in the immersion coating method, and dried at 110°C for one hour to form a 20 μm charge transport layer.

[0049]

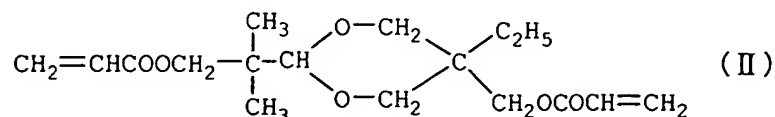


[0050] Next, a mixed solution for the protective layer was prepared in the following procedure. 100 parts of antimony containing tin oxide particulates having an average particle diameter of 0.02 μm (trade name: T-1, manufactured by Mitsubishi Materials Corp.), 30 parts of (3, 3, 3-trifluoropropyl) trimethoxysilane (Sin-Etsu Chemical Co., Ltd.), and 300 parts of 95% ethanol-5% aqueous solution were milled by a milling device for one hour. The treated solution was filtered, washed with ethanol, thereafter dried, and heated/treated at 120°C for one hour to treat the surfaces of the particulates.

[0051] Next, 25 parts of acryl monomer of the following formula (II) which was the binding resin, 0.5 part of 2-methylthioxanthone which was a photo-polymerization initiator, 35 parts of antimony containing tin oxide particles subjected to the surface treatment, and 300 parts of ethanol were mixed and dispersed by a sand mill device for 96 hours. This dispersion solution was mixed with 25

parts of polytetrafluoroethylene particles (trade name: Lpron L-2, manufactured by Daikin Industries, Ltd.) and dispersed by the sand mill device for eight hours to obtain the dispersion solution for the protective layer.

[0052]



[0053] The charge transport layer was coated with the mixed solution by the immersion coating method to form a film, the film was dried and thereafter irradiated with ultraviolet rays at a light intensity of 800 mW/cm<sup>2</sup> in a high-pressure mercury lamp for 15 seconds to form a protective layer having a film thickness of 3 μm, and the photosensitive member was obtained.

[0054] The prepared electrophotographic photosensitive member was left to stand overnight at 30°C, 85% RH, and thereafter brought into a modified machine of laser beam printer LBP-EX manufactured by Cannon Inc. in which a ratio of a time for applying the alternating-current voltage to the electrophotographic photosensitive member was changed to 50% of the total rotation time of the electrophotographic photosensitive member. A paper passage durability test of 3000 sheets was performed, and an image was sampled after 15 hours. Results are shown in Table 1.

[0055] Evaluation was also performed in the same manner

as described above except that environments were set at 40°C, 90% RH. The results are also shown in Table 1.

[0056] (Examples 2 and 3) The evaluation was performed in the same manner as in Example 1 except that the ratio of the time for applying the alternating-current voltage to the electrophotographic photosensitive member was changed to 70%, 75% of the total rotation time of the electrophotographic photosensitive member. The results are shown in Table 1.

[0057] (Comparative Examples 1 and 2) The evaluation was performed in the same manner as in Example 1 except that the ratio of the time for applying the alternating-current voltage to the electrophotographic photosensitive member was changed to 80%, 100% of the total rotation time of the electrophotographic photosensitive member. The results are shown in Table 1.

[0058] (Example 4) The electrophotographic photosensitive member was prepared in the same manner as in Example 1 except that the protective layer was not formed, and the evaluation was performed. The results are shown in Table 1.

[0059] (Examples 5 and 6) The evaluation was performed in the same manner as in Example 4 except that the ratio of the time for applying the alternating-current voltage to the electrophotographic photosensitive member was changed to 70%, 75% of the total rotation time of the electrophotographic photosensitive member. The results are



shown in Table 1.

[0060] (Comparative Examples 3 and 4) The evaluation was performed in the same manner as in Example 4 except that the ratio of the time for applying the alternating-current voltage to the electrophotographic photosensitive member was changed to 80%, 100% of the total rotation time of the electrophotographic photosensitive member. The results are shown in Table 1.

[0061] (Example 7) The electrophotographic photosensitive member was prepared and evaluated in the same manner as in Example 1 except that the solution for the protective layer was prepared without performing a series of operation in which the mixed solution for the protective layer was mixed with 25 parts of polytetrafluoroethylene particles (trade name: Lpron L-2, manufactured by Daikin Industries, Ltd.) and dispersed by the sand mill device for eight hours, and that the ratio of the time for applying the alternating-current voltage to the electrophotographic photosensitive member was changed to 60% of the total rotation time of the electrophotographic photosensitive member. The results are shown in Table 1.

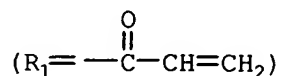
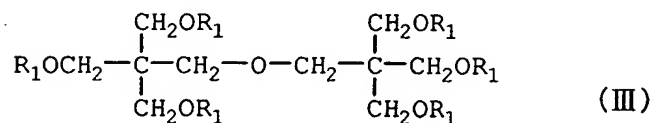
[0062] (Example 8) The evaluation was performed in the same manner as in Example 7 except that the ratio of the time for applying the alternating-current voltage to the electrophotographic photosensitive member was changed to 70% of the total rotation time of the electrophotographic

photosensitive member. The results are shown in Table 1.

[0063] (Comparative Example 5) The evaluation was performed in the same manner as in Example 7 except that the ratio of the time for applying the alternating-current voltage to the electrophotographic photosensitive member was changed to 90% of the total rotation time of the electrophotographic photosensitive member. The results are shown in Table 1.

[0064] (Example 9) The electrophotographic photosensitive member was prepared and evaluated in the same manner as in Example 1 except that 25 parts of acryl monomer of the above formula (II) as the binding resin in the mixed solution for the protective layer were replaced with 20 parts of acryl monomer of formula (II) and 5 parts of acryl monomer of the following formula (III) to prepare the solution for protective layer and that the ratio of the time for applying the alternating-current voltage to the electrophotographic photosensitive member was changed to 60% of the total rotation time of the electrophotographic photosensitive member.

[0065]



[0066] The results are shown in Table 1.

[0067] (Example 10) The evaluation was performed in the same manner as in Example 9 except that the ratio of the time for applying the alternating-current voltage to the electrophotographic photosensitive member was changed to 70% of the total rotation time of the electrophotographic photosensitive member. The results are shown in Table 1.

[0068] (Comparative Example 6) The evaluation was performed in the same manner as in Example 9 except that the ratio of the time for applying the alternating-current voltage to the electrophotographic photosensitive member was changed to 90% of the total rotation time of the electrophotographic photosensitive member. The results are shown in Table 1.

[0069]

Table 1

	Ratio of alternating-current voltage application type with respect to total rotation time of image(%)	Image level after 15 hours after durability against paper passage of 3000 sheets	
		30°C/85%RH or less	40°C/90%RH or less
Example 1	50	○	○
Example 2	70	○	○
Example 3	75	○	△
Comparative Example 1	80	△	×
Comparative Example 2	100	△	×
Example 4	50	○	○
Example 5	70	○	○
Example 6	75	○	○
Comparative Example 3	80	○	×
Comparative Example 4	100	○	×
Example 7	60	○	○
Example 8	70	○	○
Comparative Example 5	90	△	×
Example 9	60	○	○
Example 10	70	△	△
Comparative Example 6	90	×	×

Additionally, ○, △, × indicate ranks of degrees of blurring or streaming of the image, ○ is best and becomes worse to △, × in order, and × indicates the worst. Moreover, ○, △: there is no problem, and ×: there is a practical problem by the blurring or streaming.

Additionally, ○, △, × indicate ranks of degrees of blurring or streaming of the image, ○ is best and becomes worse to △, × in order, and × indicates the worst. Moreover, ○, △: there is no problem, and ×: there is a practical problem by the blurring or streaming.

[0070]

[Effect of the Invention] As described above, according to the present invention, there is provided an electrophotographic device comprising: a rotatable image

carrying member; and at least charging means, developing means, and cleaning means from an upstream side, for applying direct-current and alternating-current voltages to perform charging, wherein a ratio of a time for applying the alternating-current voltage with respect to a total rotation time of the image carrying member is 75% or less. Accordingly, there can be provided a superior electrophotographic device which is capable of obtaining a high-precision image without any blurring or streaming even at a high humidity and which has a high durability such that any image defect is not generated even after repeated use and which is capable of keeping a high image quality.



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(54) 【発明の名称】 電子写真装置

(57) 【要約】

【課題】 像担持体を直流電圧に交流電圧を重畳印加して、帯電を繰り返し行なっても、使用初期から繰り返し使用後まで高湿下でも画像の流れ、ボケのない高品位な画質を保つことのできる電子写真装置を提供する。

【解決手段】 回転可能な像担持体及び上流側より少なくとも帯電手段、現像手段及びクリーニング手段を有する電子写真装置において、該帯電を直流及び交流電圧の印加により行なうもので、像担持体の全回転時間に対し、該交流電圧印加時間の割合が7.5%以内である電子写真装置。

## 【特許請求の範囲】

【請求項1】 回転可能な像担持体及び上流側より少なくとも帯電手段、現像手段及びクリーニング手段を有する電子写真装置において、該帯電を直流及び交流電圧の印加により行なうもので、像担持体の全回転時間に対し、該交流電圧印加時間の割合が75%以内であることを特徴とする電子写真装置。

【請求項2】 前記帯電が直接帯電である請求項1に記載の電子写真装置。

【請求項3】 前記像担持体の表面層が架橋構造を有する樹脂を含有する請求項1に記載の電子写真装置。

【請求項4】 前記像担持体が電子写真感光体である請求項1に記載の電子写真装置。

【請求項5】 前記電子写真感光体が導電性支持体及び感光層をこの順に有する請求項4に記載の電子写真装置。

【請求項6】 前記電子写真感光体が感光層上に更に表面保護層を有する請求項5に記載の電子写真装置。

【請求項7】 前記感光層が電荷発生層及び電荷輸送層をこの順に有する請求項5または6に記載の電子写真装置。

【請求項8】 前記表面保護層が導電性粒子を含有する請求項6に記載の電子写真装置。

【請求項9】 前記導電性粒子が金属酸化物粒子である請求項8に記載の電子写真感光体。

【請求項10】 前記金属酸化物粒子が撥水处理されていることを特徴とする請求項9に記載の電子写真装置。

【請求項11】 前記表面保護層がフッ素原子含有樹脂粒子を含有する請求項6に記載の電子写真装置。

【請求項12】 前記クリーニング手段がブレードクリーニング手段である請求項1に記載の電子写真装置。

【請求項13】 前記クリーニング手段のブレードが弾性ゴムである請求項12に記載の電子写真装置。

【請求項14】 前記クリーニング手段のブレードの像担持体への当接圧が3～50g/cmである請求項12または13に記載の電子写真装置。

【請求項15】 前記クリーニング手段のブレードの像担持体への当接角が像担持体の回転方向に対しカウンター方向に10～45度である請求項12乃至14のいずれかに記載の電子写真装置。

【請求項16】 前記架橋構造を有する樹脂が硬化性のアクリルもしくはメタクリルモノマーまたはオリゴマーを硬化した樹脂である請求項3に記載の電子写真装置。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】 本発明は、電子写真装置に関し、詳しくは回転可能な像担持体及び上流側より少なくとも帯電手段、現像手段及びクリーニング手段を有し、該帯電を直流及び交流電圧の印加により行なう電子写真装置に関する。

## 【0002】

【従来の技術】 電子写真装置、静電記録装置等の画像形成装置において像担持体としての電子写真感光体、静電記録誘電体等の面を均一に帯電処理する工程を実行する手段機器としては従来はコロトロンやスコトロン等のコロナ放電装置が広く利用されている。これは、金属ワイヤや放電針等の放電電極に高電圧（例えばDC5～8kV）を印加し発生するコロナを被帯電体たる像担持体（以下感光体と記す）の面に作用させて帯電させるものである。

【0003】 しかし、コロナ放電器は高価な高圧電源を必要とする、それ自体や高圧電源のシールド空間等のスペースを必要とし、また、コロナ発生時にオゾンやNOx等のコロナ生成物の発生が多く、その対処のための付加手段・機構を必要とし、それ等が装置を大型化、高コスト化する因子となる、発生するコロナ生成物により感光体表面に変質を生じて画像ボケや劣化を進行させたり、放電ワイヤ汚れにより画像品質に悪影響が現われ、画像白抜けや黒スジを生じる、電力的にも感光体面に向う電流はその5～30%に過ぎず、ほとんどがシールド板に流れ帯電手段としては効率の悪い、等の問題点を有している。

【0004】 そこで、近時は問題点の多いコロナ放電器の代りに直接帯電方式の採用が検討されている。直接帯電は被帯電体面に電源により電圧を印加したローラー、ブラシ等の導電性部材（帯電用部材）を接触させることにより被帯電体面に電荷を直接注入して被帯電体面を所定の電位に直接帯電するもので種々研究され多数提案されており（特開昭56-91253号公報、同56-104351号公報、同56-185166号公報、同56-194349号公報、同57-178267号公報、同58-40566号公報、同58-139156号公報、同58-150975号公報及び同60-147756号公報等）、低電圧化できる、コロナ生成物の発生がほとんどない、構成が簡単簡素である等の特徴を有する。

【0005】 しかし、実際には感光体を上記のような接触帯電法により帯電処理しても感光体表面の各部均一な帯電はなされず、斑点状の帯電ムラを生じる。例えば、反転現象方式ではその斑点状の帯電ムラ状態の感光体に光像露光以下のプロセスを適用しても出力画像は斑点状の帯電ムラに対応した斑点状の黒点画像となり、正現象方式では斑点状のムラに対して斑点状の白点画像となり、高品位な画像は得られていないといった欠点があった。このため、直流電圧と交流電圧を重ねることにより、帯電の均一化を計ることが提案されている（特願昭61-298419号公報等）。

【0006】 複写機等の画像形成装置における像担持体上のトナー除去のためのクリーニングにおいて、ウレタゴム等のブレードエッジを像担持体表面に当接し残留

トナーを除去するクリーニング方法は知られており装置の小型化、簡略化、及びクリーニング効果の大きさ等の点から有効な方法である。

【0007】また、像担持体として用いられる電子写真感光体には、使用される電子写真プロセスに応じた所要の感度、電気特性及び光学特性を備えていることが要求されるが、更に、繰り返し使用される感光体においては、感光体の表面層、即ち支持体よりも最も隔離されている層は、帯電、トナー現像、紙への転写及びクリーニング処理等の電氣的及び機械的外力が直接加えられるため、それらに対する耐久性が要求される。具体的には、指擦による表面の摩擦や傷の発生、また帯電時に発生するオゾンによる表面の劣化等に対する耐久性が要求されている。

【0008】一方、トナーの現像及びクリーニングの繰り返しによって表面層へのトナー付着という問題もあり、これに対しては表面層のクリーニング性を向上させることが求められている。

【0009】上記のような表面層に要求される特性を満たすために、樹脂を主成分とする表面保護層を設ける試みがなされている。例えば、特開昭57-30843号公報に提案されているように、導電性粉末として金属酸化物を添加して抵抗を制御した保護層が提案されている。

【0010】しかしながら、従来用いられていた方法では金属酸化物粒子の結着樹脂中での分散性、凝集性、あるいは保護層に用いた際の導電性及び透明性に問題があり、保護層表面の不均一性、ムラ等による画像欠陥、繰り返し帯電による残留電位の上昇、及び感度低下といった現象が起り易かった。

【0011】そこで発明者らは検討の結果、特開平4-226469号公報に示すように硬化性のアクリル系モノマーまたはオリゴマーを含有する樹脂を用いると金属酸化物超微粒子の分散性が飛躍的に改善され、従ってこれを保護層に用いた場合には均質で画像欠陥のない、しかも硬度の高い電子写真感光体が得られることを発見した。

【0012】また、金属酸化物表面の吸水性は高く、その吸水の度合いより保護層の抵抗も変化してしまうため、抵抗が環境に依存し、導電性微粒子として金属酸化物を添加しただけでは、全環境下で適正な抵抗に抑えることは困難であった。そこで、この問題を解決するために、例えば特開昭62-295066号公報には結着樹脂中に撥水処理して分散性、耐湿性の向上した金属微粉末または金属酸化物微粉末を分散した保護層を用いることによって層の抵抗を制御することが提案されている。

【0013】しかしながら、像担持体を直流電圧に交流電圧を重ね印加して帯電を行なった場合には電流量が大きくなり、それに伴ってオゾンやNO<sub>x</sub>等の帯電生成物の発生量も多くなるため、元の像担持体の表面抵抗を制

御しても、帯電の繰り返しにより帯電生成物が蓄積し、表面抵抗が下がり、特に高温下で画像の流れ、ボケ等の問題があった。

【0014】

【発明が解決しようとする課題】本発明の目的は、上記の問題を解決し、像担持体を直流電圧に交流電圧を重ね印加して、帯電を繰り返し行なっても、使用初期から繰り返し使用後まで高温下でも画像の流れ、ボケのない高品位な画質を保つことのできる電子写真装置を提供することにある。

【0015】

【課題を解決するための手段】すなわち、本発明は、回転可能な像担持体及び上流側より少なくとも帯電手段、現像手段及びクリーニング手段を有する電子写真装置において、該帯電を直流及び交流電圧の印加により行なうもので、像担持体の全回転時間に対し、該交流電圧印加時間の割合が75%以内であることを特徴とする電子写真装置である。

【0016】

【発明の実施の形態】本発明に用いられる像担持体は、誘電層といわれる樹脂層を有する静電記録体と感光層を有する電子写真感光体に大別される。像担持体が電子写真感光体の場合、その構成は、導電性支持体上に感光層を有し、感光層が表面層であるものと、感光層上に更に保護層を有するものに大別される。そして感光層としては、電荷発生物質と電荷輸送物質の双方を同一の層に含有する単層型、あるいは電荷発生物質を含有する電荷発生層と電荷輸送物質を含有する電荷輸送層を積層した積層型が挙げられる。保護層を設けた場合、保護層成分の感光層中へのマイグレーションによる感光体特性劣化の問題より、積層型感光層の方が好ましい。積層型の感光層の構成としては、導電性支持体上に電荷発生層、電荷輸送層をこの順に積層したものと、逆に電荷輸送層、電荷発生層の順に積層したものがあるが、本発明においては電荷発生層、電荷輸送層の順に積層したものがより好ましい。

【0017】本発明で用いる導電性支持体は導電性を有するものであれば、いずれのものでもよく、例えばアルミニウム、銅、クロム、ニッケル、亜鉛及びステンレス等の金属をドラムまたはシート状に成形したもの、アルミニウムや銅等の金属箔をプラスチックフィルムにラミネートしたもの、アルミニウム、酸化インジウム、酸化スズ等をプラスチックフィルムに蒸着したもの、導電性物質を単独または結着樹脂と共に塗布して導電層を設けた金属、プラスチックフィルム、紙等が挙げられる。

【0018】積層型感光体の電荷発生層はスーダンレッド及びダイアンブルー等のアゾ顔料；ビレンキノン及びアントアントロン等のキノロン顔料、キノシアニン顔料；ベリレン顔料、；ンジゴ及びチオインジゴ等のインジゴ顔料；及びフタロシアニン顔料等の電荷発生物質をポリ



ビニルブチラール、ポリスチレン、ポリ酢酸ビニル及びアクリル樹脂等の結着剤樹脂に分散させて、この分散液を塗工するか、前記顔料を真空蒸着することによって形成する。このような電荷発生層の膜厚は、5  $\mu\text{m}$ 以下、好ましくは0.05~3  $\mu\text{m}$ である。

【0019】積層型感光体の電荷輸送層はピラゾリン化合物、ヒドラゾン化合物、スチリル化合物及びトリアリールアミン化合物等の電荷輸送物質を成膜性を有する樹脂に溶解させた塗工液を用いて形成され、このような成膜性を有する樹脂としてはポリエステル、ポリカーボネート、ポリスチレン及びポリメタクリル酸エステル等が挙げられる。電荷輸送層の厚さは5~40  $\mu\text{m}$ 、好ましくは10~30  $\mu\text{m}$ である。

【0020】本発明において、感光層の材料として、上記のもの他に、Se、Se-Te合金、Se-As合金、Se-Sb合金及びSe-Bi合金等の蒸着膜、PVK/TNF等の有機光導電体層、アモルファスSi感光体層、ZnOあるいはCdS等の無機光導電体を結着樹脂中に分散したもの等を用いることができる。

【0021】本発明の保護層に用いることのできる結着樹脂としては、ポリカーボネート樹脂、ポリエステル樹脂、ポリアリレート樹脂、ポリスチレン樹脂、ポリエチレン樹脂、ポリプロピレン樹脂、ポリウレタン樹脂、アクリル樹脂、エポキシ樹脂、シリコン樹脂、セルロース樹脂、ポリ塩化ビニル樹脂、ホスファゼン樹脂、メラミン樹脂及び塩化ビニル-酢酸ビニル共重合体等が挙げられる。これらの樹脂は単独で用いることも、2種以上を組み合わせて用いることもできる。

【0022】上記の樹脂の中でも、保護層の表面硬度、耐摩耗性、更に微粒子の分散性及び分散後の安定性の点から硬化性樹脂を用いることが好ましい。即ち、熱または光によって硬化するモノマーまたはオリゴマーを含有する溶液に前述の導電性粒子及びフッ素原子含有樹脂粒子を分散させて保護層用の塗工液とし、この溶液を感光層上に塗工後、硬化させて形成した保護層は、分散性、硬度及び耐摩耗性等の点でより好ましい。

【0023】熱または光によって硬化するモノマーまたはオリゴマーとは、例えば分子の末端に熱または光のエネルギーによって重合反応を起こす官能基を有するもので、このうち分子の構造単位の繰り返しが2~20程度の比較的大きな分子がオリゴマー、それより小さいものがモノマーである。該重合反応を起こす官能基としてはアクリロイル基、メタクリロイル基及びビニル基等の炭素-炭素二重結合を有する基、シラノール基、更に環状エーテル基等の開環重合を起こすもの、またはフェノールとホルムアルデヒドのように二種類以上の分子が反応して重合を起こすもの等が挙げられ、これらを含有する塗工液を塗工後、硬化して保護層を形成することによって樹脂は架橋構造を有し、高い硬度をもつようになる。この中でも特にアクリロイルまたはメタクリロイル基を

持つモノマーまたはオリゴマーは分散性に優れる。

【0024】本発明においては、分散性、結着性、耐候性を更に向上させる目的で、前記保護層中にラジカル補足剤や酸化防止剤等の添加物を加えてもよい。

【0025】本発明の保護層の膜厚は0.2~10  $\mu\text{m}$ の範囲が好ましく、より好ましくは0.5~6  $\mu\text{m}$ の範囲である。

【0026】本発明においては、クリーニング性や転写性の更なる向上のために像保持部材の表面層に潤滑粒子を含有させることが特に好ましい。潤滑粒子としては、フッ素原子含有樹脂粒子が好ましく、本発明に用いるフッ素原子含有樹脂粒子としては、四フッ化エチレン樹脂、三フッ化塩化エチレン樹脂、六フッ化エチレンプロピレン樹脂、フッ化ビニル樹脂、フッ化ビニリデン樹脂、二フッ化二塩化エチレン樹脂及びこれらの共重合体のなかから1種あるいは2種以上を適宜選択するのが好ましいが、特に、四フッ化エチレン樹脂及びフッ化ビニリデン樹脂が好ましい。樹脂粒子の分子量や粒子の粒径は、適宜選択することができ、特に制限されるものではない。

【0027】前記保護層中のフッ素原子含有樹脂粒子の割合は、表面層全重量に対し5~70重量%が好ましく、より好ましくは10~60重量%である。フッ素原子含有樹脂粒子の割合が70重量%より多いと表面層の機械的強度が低下し易く、フッ素原子含有樹脂粒子の割合が5重量%より少ないと表面層表面の離型性、表面層の耐摩耗性、耐傷性が充分ではなくなることがある。

【0028】本発明においては、フッ素原子含有樹脂粒子を樹脂溶液中でお互いの粒子を凝集させないように、保護層にフッ素系界面活性剤、フッ素系シランカップリング剤、フッ素系シリコンオイルまたはフッ素系グラフトポリマーを含有させてもよい。上述のようなフッ素原子含有化合物を含有させることにより、樹脂溶液中でのフッ素原子含有樹脂粒子の分散性及び分散安定性が格段に向上し、非常に分散性の良い塗工液が得られる。

【0029】これらフッ素原子含有化合物の添加量は、フッ素原子含有樹脂粒子の重量に対し0.1~50重量%であることが好ましく、特に1~30重量%であることが好ましい。

【0030】本発明に用いることのできるフッ素系シランカップリング剤、フッ素系シリコンオイル、フッ素系界面活性剤及びフッ素系グラフトポリマーの好ましい例を以下に例示するが、これらの化合物に限定されるものではない。

【0031】フッ素系シランカップリング剤の好ましいものとしては、 $\text{CF}_3\text{CH}_2\text{CH}_2\text{Si}(\text{OC}$   
 $\text{H}_3)_3$ 、 $\text{C}_4\text{F}_9\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ 、  
 $\text{C}_6\text{F}_{13}\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ 、 $\text{C}_8\text{F}_{17}\text{C}$   
 $\text{H}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ 、 $\text{C}_8\text{F}_{17}\text{CH}_2\text{CH}_2$   
 $\text{Si}(\text{OCH}_2\text{CH}_2\text{OCH}_3)_3$ 、 $\text{C}_{10}\text{F}_{21}\text{Si}(\text{O}$

$\text{CH}_3)_3$ 、 $\text{C}_6\text{F}_{13}\text{CONHSi}(\text{OCH}_3)_3$ 、 $\text{C}_8\text{F}_{17}\text{CONHSi}(\text{OCH}_3)_3$ 、 $\text{C}_7\text{F}_{15}\text{CONHCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ 、 $\text{C}_7\text{F}_{15}\text{CONHCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OC}_2\text{H}_5)_3$ 、 $\text{C}_7\text{F}_{15}\text{COOCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ 、 $\text{C}_7\text{F}_{15}\text{COSCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_3)_3$ 、 $\text{C}_8\text{F}_{17}\text{SO}_2\text{NHCH}_2\text{CH}_2\text{CH}_2\text{Si}(\text{OC}_2\text{H}_5)_3$ 。  
 【0032】

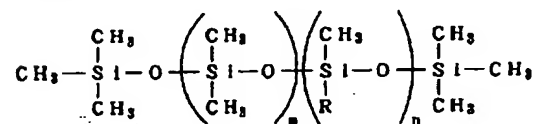


等が挙げられる。

【0034】フッ素系シリコンオイルの好ましいものとしては、

【0035】

【外3】

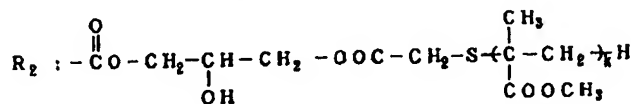
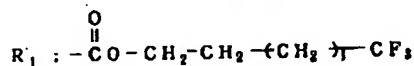
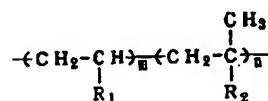


が挙げられる。但し、式中のRは $-\text{CH}_2\text{CH}_2\text{CF}_3$ を示し、m及びnは正の整数を示す。

【0036】フッ素系界面活性剤の好ましいものとしては、 $\text{X}-\text{SO}_2\text{NRCH}_2\text{COOH}$ 、 $\text{X}-\text{SO}_2\text{NRC}_2\text{H}_4\text{CH}_2\text{O}(\text{CH}_2\text{CH}_2\text{O})_n\text{H}$  (n=5, 10, 15)、 $\text{X}-\text{SO}_2\text{N}(\text{CH}_2\text{CH}_2\text{CH}_2\text{OH})_2$ 、 $\text{X}-\text{RO}(\text{CH}_2\text{CH}_2\text{O})_n\text{H}$  (n=5, 10, 15)、 $\text{X}-(\text{RO})_n\text{H}$  (n=5~20)、 $\text{X}-(\text{R})_n\text{RH}$  (n=5~20)。

【0037】

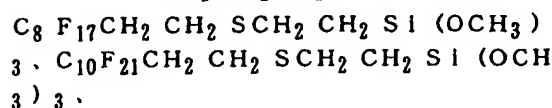
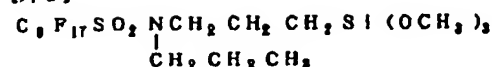
【外4】



(m、n、l及びkは整数を示す。)

【0041】本発明におけるブレードクリーニング手段に用いられるブレードの材料としては、ゴム、プラスチ

【外1】



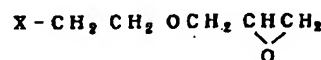
【0033】

【外2】

$\text{X}-\text{COOH}$ 、 $\text{X}-\text{CH}_2\text{CH}_2\text{COOH}$ 、 $\text{X}-\text{ORCOOH}$ 、 $\text{X}-\text{ORCH}_2\text{COOH}$ 、 $\text{X}-\text{SO}_3\text{H}$ 、 $\text{X}-\text{ORSO}_3\text{H}$ 、 $\text{X}-\text{CH}_2\text{CH}_2\text{OH}$ 。

【0038】

【外5】



等が挙げられる。但し、式中のRはアルキレン基、アリーレン基またはアラルキレン基（なお、 $-\text{NRCH}_2-$ のRはアルキル基、アリール基またはアラルキル基）を、Xは $-\text{CF}_3$ 、 $-\text{C}_4\text{F}_9$ 及び $-\text{C}_8\text{F}_{17}$ 等のフッ化カーボン基を示す。

【0039】フッ素系グラフトポリマーの好ましいものとしては、

【0040】

【外6】

ック、金属及びセラミック等が挙げられるが、中でも弾性ゴムブレードは他材質に比べてクリーニング性に優れ

ている。弾性ゴム材料としては、ウレタンゴム、ネオプレンゴム及びシリコンゴム等が挙げられるが、長期にわたって弾性を維持できるという点でウレタンゴムが特に好ましい。

【0042】本発明におけるブレードクリーニング手段は単に現像剤のクリーニング機能のみを有していればよく、クリーニングブレードの像担持体への当接圧は必要最小限とすることが好ましい。像担持体表面に与えるダメージを最小限に留め、しかも残留現像剤を有効に除去するためには、ブレードエッジの像担持体への当接角と当接圧を調節すればよく、当接角は像担持体の移動方向に対してカウンター方向に10度以上、特に45度以下であることが好ましく、また、当接圧は1~60g/cm

であることが好ましく、特に3~50g/cmであることが好ましい。

【0043】以下、実施例及び比較例により、本発明を更に詳細に説明する。

【0044】

【実施例】

(実施例1) 30φ、254mmのアルミニウムシリンダーを支持体とし、それに、以下の材料より構成される塗料を支持体上に浸漬コーティング法で塗布し、140℃で30分熱硬化することによって15μmの導電層を形成した。

【0045】

導電性顔料：酸化スズコート処理酸化チタン 10部（重量部、以下同）

抵抗調節用顔料：酸化チタン 10部

結着樹脂：フェノール樹脂 10部

レベリング剤：シリコンオイル 0.001部

溶剤：メタノール/メチルセロソルブ=1/1 20部

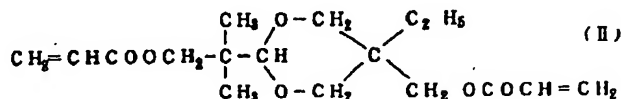
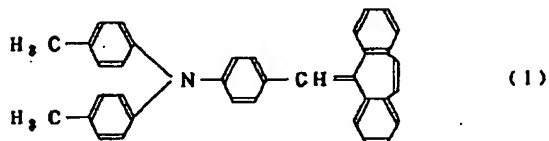
【0046】次に、この上にN-メトキシメチル化ナイロン3部と共重合ナイロン3部とをメタノール65部とn-ブタノール30部とに溶解した溶液を浸漬コーティング法で塗布して0.5μmの中間層を形成した。

【0047】次に、CuKαのX線回折におけるブラッグ角 $2\theta \pm 0.2^\circ$ が $9.0^\circ$ 、 $14.2^\circ$ 、 $23.9^\circ$ 、 $27.1^\circ$ に強いピークを有するオキシチタニウムフタロシアニン4部とポリビニルブチラール（商品名：エスレックBM-2、積水化学（株）製）2部及びシクロヘキサノン80部をφ1mmガラスビーズを用いたサンドミル装置で4時間分散した後、メチルエチルケトン115部を加えて電荷発生層用分散液を得た。これを前記中間層上に浸漬コーティング法で塗布することによって0.3μmの電荷発生層を形成した。

【0048】次に、下記式（I）で表わされる電荷輸送材料10部及びポリカーボネート（重量平均分子量25000）10部をモノクロルベンゼン30部及びジクロルメタン30部に溶解し、電荷輸送層用液を得た。これを前記電荷発生層上に浸漬コーティング法で塗布し、110℃で1時間乾燥することによって20μmの電荷輸送層を形成した。

【0049】

【外7】



【0053】この調合液を用いて前記電荷輸送層上に浸漬コーティング法で塗布して成膜し、乾燥後高圧水銀灯にて800mW/cm<sup>2</sup>の光強度で15秒間紫外線照射して膜厚3μmの保護層を形成し、感光体を得た。

【0054】作製した電子写真感光体を30℃、85%RH下で一晩放置後、電子写真感光体への交流電圧の印加時間の割合を電子写真感光体の全回転時間の50%に変えたキヤノン製レーザービームプリンターLBP-EXの改造機に入れ、3000枚の通紙耐久を行ない、15時間後に画像サンプリングを行なった。その結果を表1に示す。

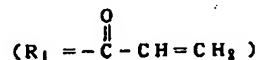
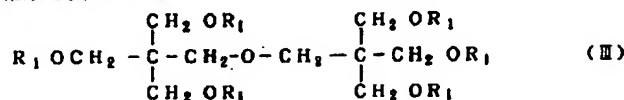
【0055】また、環境を40℃、90%RHにする以外は上記と同様に評価を行なった。その結果も表1に示す。

【0056】(実施例2及び3)電子写真感光体への交流電圧の印加時間の割合をそれぞれ電子写真感光体の全回転時間の70%、75%に代えた以外は実施例1と同様に評価を行なった。その結果を表1に示す。

【0057】(比較例1及び2)電子写真感光体への交流電圧の印加時間の割合をそれぞれ電子写真感光体の全回転時間の80%、100%に代えた以外は実施例1と同様に評価を行なった。その結果を表1に示す。

【0058】(実施例4)保護層を形成しなかった他は実施例1と同様に電子写真感光体を作製し、評価を行なった。その結果を表1に示す。

【0059】(実施例5及び6)電子写真感光体への交流電圧の印加時間の割合をそれぞれ電子写真感光体の全回転時間の70%、75%に代えた以外は実施例4と同様に評価を行なった。その結果を表1に示す。



【0066】その結果を表1に示す。

【0067】(実施例10)電子写真感光体への交流電圧の印加時間の割合を電子写真感光体の全回転時間の70%に代えた以外は実施例9と同様に評価を行なった。その結果を表1に示す。

【0068】(比較例6)電子写真感光体への交流電圧

【0060】(比較例3及び4)電子写真感光体への交流電圧の印加時間の割合をそれぞれ電子写真感光体の全回転時間の80%、100%に代えた以外は実施例4と同様に評価を行なった。その結果を表1に示す。

【0061】(実施例7)保護層用の調合液で四フッ化エチレン樹脂(商品名:ルプロンL-2、ダイキン工業(株)製)25部を混合してサンドミル装置で8時間分散する一連の作業を行わずに保護層溶液を調合し、電子写真感光体への交流電圧の印加時間の割合を電子写真感光体の全回転時間の60%に代えた以外は実施例1と同様に電子写真感光体を作製し、評価を行なった。その結果を表1に示す。

【0062】(実施例8)電子写真感光体への交流電圧の印加時間の割合を電子写真感光体の全回転時間の70%に代えた以外は実施例7と同様に評価を行なった。その結果を表1に示す。

【0063】(比較例5)電子写真感光体への交流電圧の印加時間の割合を電子写真感光体の全回転時間の90%に代えた以外は実施例7と同様に評価を行なった。その結果を表1に示す。

【0064】(実施例9)保護層用の調合液中の結着樹脂を前記式(II)のアクリルモノマー25部の代わりに式(II)のアクリルモノマー20部及び下記式(III)のアクリルモノマー5部に代えて保護層溶液を調合し、電子写真感光体への交流電圧の印加時間の割合を電子写真感光体の全回転時間の60%に代えた以外は実施例1と同様に電子写真感光体を作製し、評価を行なった。

【0065】

【外9】

の印加時間の割合を電子写真感光体の全回転時間の90%に代えた以外は実施例9と同様に評価を行なった。その結果を表1に示す。

【0069】

【外10】

	像担持体の全回転時間 に対する交流電圧印加 時間の割合 (%)	3000枚通紙耐久後15時間後の画像レベル	
		30℃/85%RH下	40℃/90%RH下
実施例1	50	○	○
2	70	○	○
3	75	○	△
比較例1	80	△	×
2	100	△	×
実施例4	50	○	○
5	70	○	○
6	75	○	○
比較例3	80	○	×
4	100	○	×
実施例7	60	○	○
8	70	○	○
比較例5	90	△	×
実施例9	60	○	○
10	70	△	△
比較例6	90	×	×

ただし、○、△、×は画像のボケ、流れの程度のランクを示し、○が最も  
 良く、△、×の順に悪くなり、×が最も悪いことを示す。またそれぞれ○、  
 △：問題なし、×：ボケ、流れにより実用上問題ありを示す。

## 【0070】

【発明の効果】以上のように本発明によれば、回転可能  
 な像担持体及び上流側より少なくとも帯電手段、現像手  
 段及びクリーニング手段を有し、該帯電を直流及び交流  
 電圧の印加により行なう電子写真装置において、像担持

体の全回転時間に対し、該交流電圧印加時間の割合が7  
 5%以内であることで、高湿下でもボケ、流れのない高  
 精細な画像が得られ、高耐久で繰り返し使用後まで画像  
 30 欠陥が生じず高品位の画質を保つことのできる優れた電  
 子写真装置を提供することができる。

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